there was no preface, the editors were unable to say how very much it owed to Mr. Wilson's skill and care.

To the list of cave animals which appears in Dr. A. S. Packard's monograph in the "Cave Fauna of North America" must now be added seven forms which are new to science, and several forms which, while known, have not hitherto been definitely reported from Mammoth Cave, Kentucky. This new material is described by Dr. Ellsworth Call in the *American Naturalist* (May). The specimens described are very minute, and this fact is in itself sufficient to explain their late appearance in lists of the cave fauna. The paper is a noteworthy contribution to a knowledge of the life of the most interesting cave on the American Continent.

A reprint from the *Transactions* of the New York Academy of Sciences gives an account of the results obtained by an expedition to Puget Sound, organised by the Department of Zoology of Columbia University in the summer of 1895. The party consisted of six members, under the leadership of Dr. Bashford Dean. Their main object was to obtain materials for the study of the development of the Chimeroid fish *Hydrolagus*, and eggs and young of the Myxinoid form *Bdellostoma*, both known to be abundant there. In both these respects success was achieved, and large collections of other groups of marine animals were secured for future study.

Among noteworthy articles which have come under our notice during the past few days are the following:—Dr. R. W. Shulfeldt points out, in the *Photogram* (June), that many of the figures throughout zoological literature are very frequently anything but correct, depicting often the subject in impossible attitudes, badly proportioned, and with erroneous portrayal of characters. To assist in the improvement of this state of things, he describes how photography should be called in with the view to secure pictures of living animals for reproduction by photographic processes.—The *Century Magazine* for May contains three well-illustrated articles on the construction and use of kites for meteorological and photograph purposes. In the June number of the same magazine, Mabel L. Todd describes the establishment and work of the Harvard College Observatory.—An address on "The Problems of Astronomy," delivered by Prof. Simon Newcomb at the dedication of the Flower Observatory, University of Pennsylvania, is printed in *Science* of May 21.

Some further details, of great interest as to the fermentation of sugar in the absence of yeast-cells (see NATURE, March 11, p. 442), are given in the current number of the *Berichte* by Buchner. The active extract of yeast very rapidly loses its power of producing fermentation, owing probably to the presence of peptic enzymes. The activity of the solution is not affected by the presence of antiseptic substances, and the solid residue left on evaporation at a low temperature is found to yield an active solution, even after having been kept for nearly three weeks. These facts seem to definitely prove that the fermentation in these cases is not brought about by living protoplasm in any form, but is really due to the substance which the author has termed zymase. This is further confirmed by the fact that dried yeast which has been heated at 100° for six hours, and is incapable of further development, still yields an active solution when treated with sterilised 37 per cent. sugar solution.

The additions to the Zoological Society's Gardens during the past week include a Chimpanzee (young) (*Anthropopithecus troglodytes*, ♀) from West Africa, presented by the Hon. Sir W. Grantham; a West African Sheep (*Ovis aries*, var. ♂) from West Africa, presented by H.E. Colonel F. Cardew, C.M.G.; a Broad-snouted Cayman (*Caiman latirostris*) from South America, presented by Mr. C. L. Hutchings; an Olive-brown Snake (*Phrynonax fasciatus*) from Trinidad, presented by Mr. R. R. Mole; a Pleasant Antelope (*Tragelaphus gratus*, ♂), four Royal Pythons (*Python regius*) from West Africa, thirteen Cunningham's Skinks (*Egernia cunninghami*), two Punctulated Tree Snakes (*Dendrophis punctulatus*) from Australia, deposited; an Alpaca (*Lama pacos*, ♂) from Peru; two Red-topped Amazons (*Chrysotis rhodocorytha*), three White-eared Conures (*Pyrrhura leucotis*) from Brazil, purchased; two Japanese Deer (*Cervus sika*, ♂ ♂), a Red Deer (*Cervus elaphus*, ♀). a Burrhel Sheep (*Ovis burrhel*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Rotation Period of Jupiter's Satellite III.—Mr. Douglass has quite recently determined the period of rotation of Ganymede, Jupiter's third satellite, the period being given as 7 days, 5 hours (Kiel Telegram). This satellite is the brightest and largest of them all, and its sidereal revolution is 7 d. 3 h. 43 m., so that the period of rotation is practically the same as the time of its orbital revolution. This observation partly corroborates what Herschel concluded in 1797, namely, that, like our moon, all the satellites of Jupiter turn the same face towards their primary, thus always presenting to us, when in the same relative situations, the same obscure or brilliant sections of their globes. Engelmann's researches in 1871, and C. E. Burton's, two years later, made this statement of Herschel's almost certain regarding the outer satellite, and since that time it has always seemed probable that it would also apply to the other three. This new observation of Mr. Douglass shows that the deductions of the earlier observers were not very far from the truth.

Referring to this satellite in 1893, Prof. W. H. Pickering (*Astronomy and Astrophysics*, vol. xii. p. 199) said: "On account of its size and brightness, this is much the easiest satellite to observe. Indeed, even the occasionally elliptical shape of its disc has been noted by Lassell, Secchi and Burton. . . . Like our moon, therefore, its period of rotation coincides, at least approximately, with that of its revolution in its orbit. . . . Its surface markings are readily seen, especially during transit, the most conspicuous being a dark belt situated in the northern hemisphere, and inclined about fifteen degrees to its orbit."

Automatic Photography of the Corona.—The idea of connecting several different kinds of instruments with some sort of central automatic arrangement by which one man may work them all during a total eclipse of the sun, is not new; but weather conditions have up to the present prevented any trial being made at the time of an actual eclipse. Mr. David P. Todd, who for the past few years has given considerable attention to this question, describes in the current number of the *Astrophysical Journal* (No. 5, vol. v.) the special automatic shutter and electric commutator which was devised for the Amherst Eclipse Expedition of last year, but which was, unfortunately, not used owing to the bad weather. In all twenty photographic instruments would have been worked by an automatic system, which would have given more than four hundred exposures with several types of reflecting and refracting telescopes, photographic doublets, a pair of spectroscopes, photometers, and a pair of polariscopes.

The system which Mr. Todd advocates is an electric system of control, and he has found that it is perfectly competent to operate any available number of eclipse instruments adapted for photographic purposes; it further makes the time record of every automatic movement in a form which can be identified.

It would be difficult to give the reader a clear idea of this arrangement without the medium of an illustration; so that we refer him to Mr. Todd's article for detailed information.

The Gegenschein or Zodiacal Counterglow.—In some former numbers of the *Astronomical Journal* (*A. J.*, vii. 186, xi. 19, and xiii. 169), Prof. Barnard contributed his observations of this phenomenon as seen at the Lick Observatory. His communication to a more recent number (No. 403) of the same journal contains some further observations of considerable interest made at the Yerkes Observatory. He

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points out that although these naked-eye observations are subject to a more considerable personal error than if they could have been made with any kind of instrument, yet the determination of the position of this phenomenon depends to a great deal on the experience of the observer. The best method he suggests for its location is to estimate the distance of its centre from the nearest fixed star, and then to identify the star by a chart or an equatorial pointing; by this means he can ordinarily determine the centre to within one degree. Any attempt, he says, to locate its position by tracing the outlines among the stars can only lead the observer to very crude results. Prof. Barnard's observations have indicated that the Gegenschein seems subject to periodical changes in the first parts of October and April; but the weather this year did not permit of a corroboration of this statement. The present observations show that this phenomenon has a north latitude as formerly, and that there is still a tendency to lag in longitude; that is, its longitude is not exactly 180° greater than that of the sun. The following summary shows the results for the last fourteen years:—

Dates.	Lat.	Diff. Long. (λ – ⊙)	No. Obs.
1883–1887	+0°·4	179°·4	16
1888–1891	+1·3	179·4	16
1893	+0·5	179·6	22
1894–1897	+0·4	179·9	11

It may be stated that the difference in longitude for the last four years given above is rather high, owing to the fact that the three observations of 1894 made the difference greater than 180°. Those for 1895 and 1897 gave a value considerably less than 180°.

PERIODIC VARIATIONS OF RAINFALL IN INDIA.

THE meteorology of India during the past five years, 1892-96, has been characterised by the largest and most marked periodic variation of rainfall during the past fifty years at least, and probably for a much longer period. The late Mr. Blanford's monograph on the rainfall of India (page 15) gives a brief statement of the method he adopted for ascertaining the average rainfall of India, year by year, and the normal average. According to this method the mean normal annual rainfall of India is, very approximately, 41 inches. The following gives a comparison of the actual mean rainfall of India with the normal mean for each year from 1875 to 1896, determined by Mr. Blanford's method.

Year.	Mean actual Rainfall.	Variation from normal.	Percentage variation.
	Inches.	Inches.	
1875	43·47	+ 2·38	+ 6
1876	36·60	– 4·49	– 11
1877	36·81	– 4·28	– 10
1878	47·43	+ 6·34	+ 15
1879	42·78	+ 1·69	+ 4
1880	39·53	– 1·56	– 4
1881	41·19	+ 0·10	0
1882	43·73	+ 2·64	+ 6
1883	40·97	– 0·12	0
1884	42·82	+ 1·73	+ 4
1885	42·14	+ 1·05	+ 3
1886	44·11	+ 3·02	+ 7
1887	43·51	+ 2·42	+ 6
1888	39·55	– 1·54	– 4
1889	43·50	+ 2·41	+ 6
1890	41·77	+ 0·68	+ 2
1891	37·55	– 3·54	– 9
1892	46·18	+ 5·09	+ 12
1893	50·16	+ 9·07	+ 22
1894	47·56	+ 6·47	+ 16
1895	38·90	– 2·90	– 7
1896	36·26	– 4·83	– 12

The preceding data indicate that from 1876 to 1891 the annual ainfall of India varied somewhat irregularly and by less than 10 per cent. from the normal with one exception, viz. during the period 1876–78. The meteorological features of this period were very remarkable (*vide* NATURE, vol. xxi., page 477, "On the barometric see-saw between Russia and India in the sun-spot cycle," by H. F. Blanford), the most noteworthy being the drought and famine in Madras in 1876, and the scanty rainfall in North-western India in 1877, which gave rise to considerable suffering. Mr. Blanford subsequently traced the cause of the deficient rainfall in North-western India in 1877 to conditions and actions resulting from excessive snowfall in the Himalayan region during the winter of 1876–77.

The causes of the drought in Mysore and the Madras and Bombay Deccan in 1876, have as yet not been fully ascertained. The snowfall of the winter of 1875–6 was unusually scanty in the North-western Himalayas, although there was a heavy local fall in March and April in a part of the Kashmir Himalayas. The Madras drought and famine was probably due to more general actions and conditions than the winter Himalayan snowfall.

The present meteorological period of abnormal conditions and rainfall it will, however, be seen is not only more prolonged, but is accompanied by much larger variations in the amount and distribution of the rainfall than were experienced in the period of 1876–78. It is, moreover, noteworthy that the cycle or period commenced with excessive rain, continued for a period of three years, and culminating in the year 1893 in an average excess of 9·07 inches, or 22 per cent. of the normal fall. This excess rainfall in India in 1893 was equal to the amount of water necessary to supply its largest canal, the Ganges canal, 300 feet wide, 10 feet deep, for a hundred years. This comparison gives a feeble estimate of the surplus water precipitated over India in 1893, in consequence of the special meteorological conditions and actions of the period.

In order to understand the causes of the partial failure of the crops over at least two-thirds of India in the year 1896, it is necessary to bear in mind the more prominent features of its meteorology, that differ very largely from the meteorological conditions in European countries. The following is a brief statement of the chief features of the two monsoon periods in India.

The year in India may be broadly divided into two seasons or monsoons—viz. the north-east monsoon and the south-west monsoon. These names are derived from the direction of the winds prevailing in the Arabian Sea and Bay of Bengal during the two periods. They are inapplicable over the greater part of India, where the winds are from directions nearly opposite to those indicated by the names of the seasons, and are chiefly determined by the axial directions of the local river valleys. Thus the winds in South Bengal are from south-east, and in Bihar from east, during the south-west monsoon, and are from the opposite directions in the north-east monsoon. It would hence be more appropriate to call the two seasons in India the dry monsoon, and the wet monsoon from their most characteristic features.

The dry monsoon or season usually commences in November or December, and continues until May. Winds of land origin prevail more or less steadily in the interior, and hence the period is usually marked by great dryness of the air and little or no rain. The first three months of this period (December to February), characterised by a comparatively low temperature, are known as the cool weather season; and the second three months (March to May), when the temperature increases rapidly, and culminates in a period of excessive heat in May, as the hot weather season. During the cold weather season, shallow depressions of large extent, the majority of which form in Persia, enter India from Baluchistan and traverse Northern India from west to east, distributing light rain in the Indo-Gangetic plains and heavy snow over the Western Himalayas. The severity of the hot weather season is occasionally relieved by the occurrence of series of thunderstorms and duststorms, which cool the air for brief periods. Over nearly the whole of the interior of India the cold weather and hot weather disturbances occupy a very small portion of the period, and the characteristic features of the dry season are persistent dry weather, with clear skies and large diurnal range of temperature.

The chief crops in Northern and Central India during this period are wheat, barley, linseed, &c., and irrigation either from canals, tanks, or wells is essential in almost all districts for their successful cultivation. If the summer rains cease much earlier than usual, it is not possible to plough and sow the higher

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